# STRAIN GAGING TECHNIQUE FOR BONES IN INTACT CADAVERS

by

William R. Powell and Sunder H. Advani
Department of Mechanical Engineering and Mechanics
West Virginia University

As part of a research contract on the response of cadavers to knee impacts, we measured strains on intact cadaver femurs. Three major problems had to be overcome to obtain these measurements; obtaining a good bond between the gage and the moist bone, insulating the gage from electrical noise transmitted by the body fluids, and protecting the gage leads during large soft tissue movements.

The strain gages used were 350 ohm encapsulated metal foil gages with short lead wires attached (Micro-Measurements, Inc., EA 13-250AE-350 option LE). We prepared the gages for mounting using the following procedure. The leads were soldered to the ends of a two strand shielded cable with the cable shield grounded to the strain gage bridge amplifier. Using strain gage adhesive (Micro-Measurements, M-Bond 200) a thin sheet of butyl rubber was bonded to the top of the gage, the soldered lead wires and approximately 1/4 inch of the cable. A second sheet of rubber was bonded to the first covering the opposite side of the cable, the leads and the edge of the bottom of the gage. Care was taken not to cover any of the gage foil grid with this second sheet. The rubber sheets, Figure 1, insulate the gage from the body fluids and provide a rigid connection between the cable and the gage. Calibration of the gages on aluminum tension specimens showed no strain distortion due to the protective sheeting.

Bone preparation consisted of scraping off all soft tissue, lightly sanding with emery cloth and repeated drying of the surface with ether. This produced a dry enough contact surface that the gages could be attached with M-Bond 200 for periods up to two weeks. First the gage, rubber sheet and bone surface were coated with the adhesive catalyst, then the M-Bond 200 was liberally applied to the gage and rubber sheet and they were pressed onto the bone. The mounted gages were covered with a gauze sponge and the incision closed.

This gaging technique protected the gage leads from being torn off by tissue movement during impact loadings and isolated the gage from the moist body tissues and electrical noise. We have used the technique successfully on both embalmed and fresh cadavers. The method offers fast and convenient gage mounting, because all the gage protection can be completed before the start of the cadaver experiment.

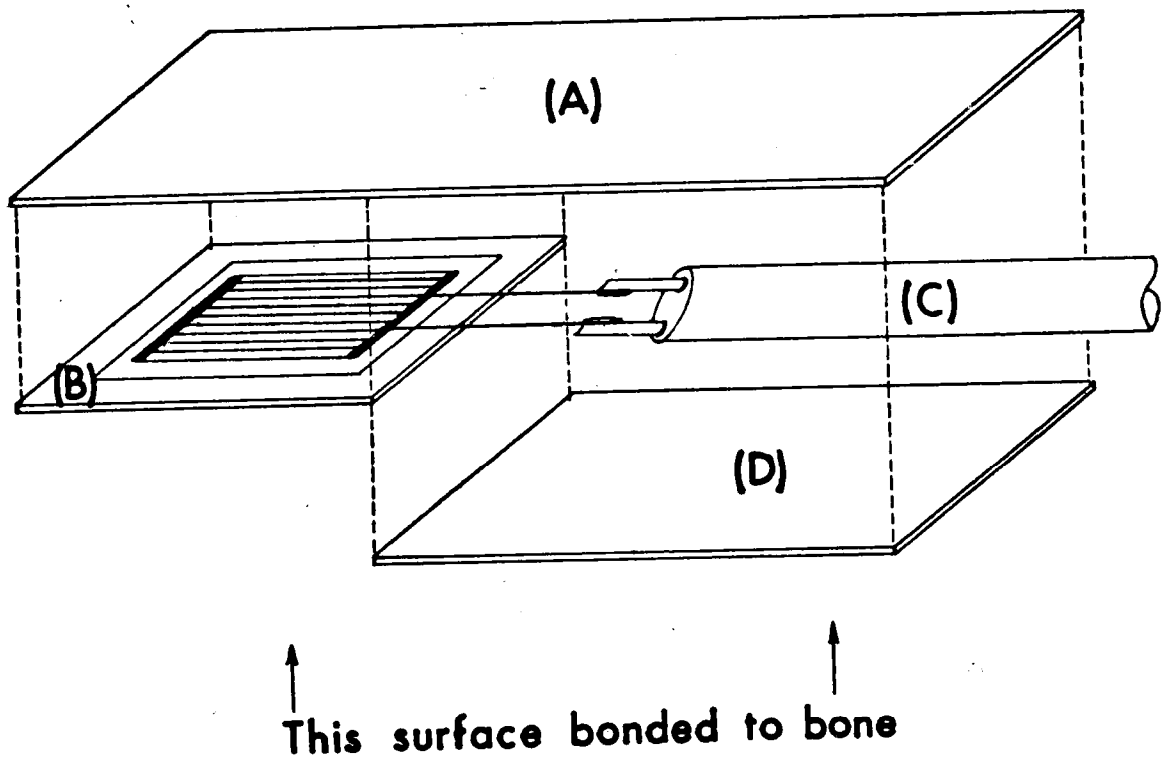


Figure 1 Expanded view of gage showing upper protective rubber sheet (A), encapsulated strain gage (B), shielded cable (C), and the lower rubber sheet (D).